Barriers and facilitators of the Electronic Community Health Information System (eCHIS) in Ethiopia: Practical Guidance for improved its implementation guided by the Consolidated Framework for Implementation Research (CFIR)

Afrah Mohammedsanni Omer[1*], Anteneh Kinfe[1], Wubshet Denboba[1], Eyerusalem Kebede[2], Dawit Birhan[1], Tsega Hailu[2], Emebet Alemu[2], Asfaw Kelbesa[2], Oli Kaba[2], Chaluma Kumela[1], Amanuel Biru[1], Gemechis Melkamu[2], Naod Wendrad[2], Gebretsadik Keleb[1], Abebaw Gebeyehu[1]

Abstract

Background- Despite the priority given to the electronic Community Health Information System (eCHIS) in Ethiopia, after three years of its implementation, health extension workers are not yet fully benefited from the system. Household registration remains incomplete, and service provision is very limited.

Methods- A qualitative case study was conducted from September 2021 to December 2021, enrolling 32 key informants who were purposively selected from diverse stakeholder organizations across four regions of Ethiopia. This study assessed the key factors facilitating and impeding eCHIS implementation by involving stakeholders ranging from service providers to policymakers and partner organizations, guided by the comprehensive Consolidated Framework for Implementation Research (CFIR).

Findings and practical implications- eCHIS offers several promising advantages, including ease of use, reduced workloads, standardized services, improved data quality, and enhanced service delivery and referral linkages. Organizational structures such as Technical Working Groups (TWGs) at all levels and an eCHIS Center of Excellence have the potential to improve and institutionalize eCHIS implementation in the country. Thus, strengthening the support forum and the regularity and functionality of TWG meetings at all levels is essential. However due to poor documentation and monitoring mechanisms, as well as the absence of a functional feedback loop, eCHIS goals are often not acted upon. Activities are not sufficiently followed up, and progress is not checked against feedback. Insufficient resources to fully support eCHIS represent significant challenges that require further resource mobilization in the future. Additionally, collaborative effort with all key stakeholders and active engagement from leaders are critical to optimizing eCHIS implementation.

Conclusion- eCHIS has demonstrated numerous advantages and a promising future in terms of improving service delivery, data quality, and utilization. .However, challenges like limited customization, lack of clear guidelines, and insufficient resources hinder its successful implementation. Addressing these issues, including securing dedicated funding and technical support, is crucial for long-term sustainability of the program. [*Ethiop. J. Health Dev*. 2024; 38(SI-2)]

Keywords: Electronic Community Health Information System (eCHIS), Barriers and Facilitators, Determinants, Consolidated Framework for Implementation Research (CFIR), Health Information System, Ethiopia

Background

The Electronic Community Health Information System (eCHIS) is a high-priority initiative that reflects the Ethiopia Ministry of Health's (MOH) commitment to using technology-driven data to improve the community-level provision of promotive, preventive, and basic curative health services. Despite the emphasis placed on eCHIS in Ethiopia, after three years of its implementation, HEWs have not yet fully benefited from the system, household registration remains incomplete, and service provision is very limited.

eCHIS was introduced in the Ethiopian health system in 2018 with the goal of digitizing and transforming health service delivery at the community level to inform decision making(1). The main objective of the program is to serve as a job aid for HEWs during service provision. The system is implemented at the health post and health center levels to improve referral linkages, data quality, and the culture of data use for evidence-based decision making (2,3). Health posts are staffed with health extension workers. Currently, the digitized version of CHIS is being rolled out in eight regions name Amhara, Oromia, Tigray, Benishangul Gumuz, SNNP, Sidama, Dire Dawa and Harari. By 2022, eCHIS is implemented in over 4000 health posts and health centers. (4).

The implementation of eCHIS is based on the existing CHIS implementation structure. The digitized CHIS currently have four main modules: digital family folder, reproductive maternal newborn and child health (RMNCH), Disease prevention and control (DPC) and Logistic supply and management modules. The digital family folder and reproductive, maternal, newborn and child health (RMNCH) modules are being implemented across the regions, While the disease prevention and control (DPC) module is currently in the piloting phase and the logistics supply and management module is not finalized (4).

The successes of evidence-based interventions such as eCHIS are determined by a wide range of pragmatic factors that require thorough assessment and tailored strategic interventions. However, to date, evidence

[1] JSI-Ethiopia Data Use Partnership; Addis Ababa, Ethiopia
[2] Ethiopia Ministry of Health; Addis Ababa, Ethiopia
[*]**Corresponding author Afrah Mohammedsanni Omer-afrahsanni@gmail.com**

regarding the determinants that influencing eCHIS implementation and their implications for policy and practice in the country are sparse.

This research aimed to identify major determinants of eCHIS implementation in Ethiopia and provide insights for practice and policy to support timely decision making.

The findings of this study have already been put to use by MOH to enhance the adaptation of eCHIS within the country's health system. These include developing national eCHIS strategy, aligning plans with the regional health offices, and granting select features of the eCHIS software to regional staff.

Methods

A qualitative case study was conducted from September 2021 to December 2021 in four regions of Ethiopia; Amhara, Oromia, SNNP and Sidama. Key informants were selected from relevant organizations working on eCHIS in Ethiopia. These organizations include the Ethiopian Ministry of Health, Regional, Zonal and District health bureaus, Health centers, Health posts (Health Extension Workers), eCHIS center of excellence (Jimma University) and partner Non-Governmental Organizations. The research team conducted a stakeholder mapping exercise to identify key informants for qualitative interviews. Respondents were chosen based on their involvement in the development and implementation of eCHIS software in Ethiopia.

Data collection tool and procedure

The research team developed a qualitative interview tool guided by the Consolidated Framework for Implementation Research (CFIR) framework. The CFIR is widely used in implementation research due to its comprehensive overarching typology of constructs, which includes multidimensional factors that influence the implementation of interventions. The CFIR framework contains five major domains: 1) intervention characteristics, 2) inner setting 3) outer settings, 4) individual characteristics, and 5) implementation process. According to the framework, these domains interact to influence implementation effectiveness (5).

A total of 32 interviews were conducted with key informants selected from relevant stakeholder organizations. Informed consent to conduct and record interviews was obtained from respondents prior to the interviews. Four experienced data collectors conducted a face-to-face interview with key informants. The Interviews were audiotaped without including names and personal identifiers of respondents.

Data management and analysis

Audiotaped interviews were translated into English language verbatim. Atlas.ti Software was used for coding and analysis. After importing all transcripts in the software, the interviews were coded as they emerged and further categorized under the CFIR constructs in consensus within the research team. The findings from this study are presented under the CFIR domains.

Findings

Key informant characteristics

A total of 32 key informants from were selected from the Ministry of (MOH), Amhara, Oromia, SNNP and Sidama Regional Health Bureaus (RHBs), Amhara and Oromia Zonal Health Departments (ZHDs), Wolmera and Dangla Zuria Woreda Health Offices (WoHos), Primary Health Care Units (PHCUs), Health Posts (HPs), eCHIS center of excellence, and partner organizations. These participants have varying expertise related to eCHIS in Ethiopia including eCHIS team leads at the MOH, directors of HITD and PPMED, HEP focal persons, HIS specialists, Monitoring and Evaluation (M&E) specialists and Health Extension workers.

Present the socio-demographic characteristics of your respondents using a table for easy visualization.

Table 1: **Number of key informants and corresponding organizations**

Organization	No.
Ministry of Health	5
Implementing Regional Health Bureau	8
Zonal Health Departments	2
Woreda Health Offices	2
Primary Health Care Units	4
Health Posts	7
eCHIS center of excellence	1
L10K	1
DHA	1
DUP	1
Total	**32**

Major factors under CFIR domains

All CFIR domains and the majority of the constructs and sub-constructs emerged from our interviews. The domains include 1) Intervention characteristics 2) Outer setting 3) Inner setting 4) Individual characteristics 5) Process. Sub-constructs such as Culture, tension for change, learning climate, opinion leaders, champions, and external change agents are some of the constructs that didn't emerge from our interviews.

The findings from qualitative interviews are summarized under the 5 CFIR domains as follows.

Intervention characteristics *(Evidence strength and quality, Relative advantage, Adaptability, Trial ability, Complexity, Design quality and packaging, Cost)*

The ability to modify and tailor CommCare software by local developers aids in adaptation the intervention into the country's context. However, a drawback of CommCare is that it does not support a feature to display organizational hierarchy on the tablets used by HEWs. This limitation can lead to data mix ups, between health posts with similar names in Sidama Region, which negatively impacts data quality. Fortunately, this issue was identified and resolved by the regional health office.

Stakeholders indicated that the eCHIS system is centralized, which hampers timely responses at the regional level. Additionally, the lack of access to generate custom reports at regional and lower levels, along with the absence of household and population targets in the application software, negatively influenced monitoring and quality assurance activities.

"*We generate a report at the regional level, but it is limited and does not meet our need… We can select the date and the facility for which we need to generate a report. While there are ready-made report formats, they are not flexible and do not allow us to generate a reports in the way we need."* stated a representative from RHB HIT.

The MoH piloted eCHIS modules in selected health posts. However, some regional stakeholders mentioned that they were unaware of the availability of pilot testing before the scale- up of eCHIS modules. Additionally, expert testing, User Acceptance Tests (UATs), and translation of modules into local languages facilitated adaptation of the intervention. However, inconsistencies in language translations were noted in some areas that affected service provision.

"I don't know if piloting was done at the beginning of the program by the MOH, I know that the MoH has conducted master Training of Trainers (ToT), and then we went directly into the implementation of the program. Pilot testing was not done, and the service modules were not tested." (Regional HIT director).

Stakeholders unanimously agreed that eCHIS is an improvement paper-based CHIS, as it provides ease of use, reduce the workload for health extension workers, facilitate standardized service, promotes data quality, and enables easy information exchange and interpretation. Additionally, the design of eCHIS as a job aid helps in providing comprehensive and standardized services. However, there is a risk of data loss from the tablets if data is not synched in a timely manner and if servers fail to back up the data. Using an easy to carry electronic tablet-based system also made the work of HEWs more efficient allowing them to easily retrieve data wherever they are.

"eCHIS is the digital version of CHIS: it can handle large amounts of data on a single tablet within a computerized system. It simplifies work, it saves information on one platform, and allows us to carry the data with our tablets. What is registered is sent to the server immediately, allowing data that can be shared with health centers and higher levels," (RHB HEP focal)

Another Health Extension Worker (HEW) supports this idea by sharing her experience:

"It is better to provide service using eCHIS than CHIS because it serves as a job aid. It guides us on how to counsel mothers and maintain the quality of service". She stated (Health extension worker)

Moreover, Stakeholders indicated that although the initial cost of eCHIS is high, its ongoing cost of eCHIS is relatively lower than those of CHIS.

"Compared to the manual CHIS, implementing eCHIS is cheaper. The system is dynamic; everything is continuously changing indicators are revised, and tools are updated simultaneously. As a result, revising and printing paper materials cost hundreds and millions, whereas on the electronic version, we can updates the tools and send them directly to the devices used by the HEWs. Thus, even if the initial capital cost is substantial, the running costs for minimal." (KII, Partner organization)

Conversely, the challenges faced by HEWs in adapting to mobile technologies were described as follows:

"…HEWs are encountering difficulties in adapting to technology. They struggle to fix simple errors and do not have alternate solutions if the connection fails to synch the data. They are even unable to resolve date and time issues; they are not fully equipped to adapt to these technologies," noted the regional eCHIS focal person)

Outer setting*: -* ***Client needs and resources, Cosmopolitanism, Peer pressure, External policy and incentives***

Although eCHIS is designed to serve as a job aid for providing standardized services, HEWs reported that the increased waiting time related to providing service using eCHIS made clients frustrated. Networking with other organizations working on eCHIS through review meetings and steering committees, where teams exchanged experiences and discussed challenges was noted as one of the facilitating factors for eCHIS implementation in the country.

In some areas, the best performing health extension workers were (HEWs) were selected to participate and showcase their skills during eCHIS training. This approach has been observed to motivate HEWs to improve their performance.

".. during service provision, eCHIS do not allow users skip certain information. so, filling all data with the client and providing counseling service following eCHIS job aid creates challenges, as it takes time and increases the waiting times for clients…… clients mainly complain about the long waiting time during family planning service provision". (Health extension worker)

Despite the availability of roadmaps for the Information Revolution and HEP optimization, as well as HEW program implementation guidelines, stakeholders cited a lack of clear guidance and eCHIS-specific governing documents such as training

facilitators guides, end-user guides, tablet management guidelines, and incentive strategies, as factors impeding eCHIS implementation. Stakeholders also mentioned the absence of governing documents like as stakeholder engagement frameworks for partners working on eCHIS and eCHIS center of excellence. To this end, the ministry developed a manual to guide stakeholders' support for eCHIS implementation which is yet to be approved and disseminated.

"… eCHIS doesn't have a training manual. It only has a PowerPoint. It also doesn't have an end-user manual which is one of the challenges. We also haven't prepared eCHIS implementation manual at the regional level". (RHB plan, M&E director)

Inner setting*: - Structural characteristics, Networks and communications, Culture, Implementation climate, Readiness for implementation*

Stakeholders mentioned the availability of a Technical Working Group (TWG) at MOH level. this group is a coalition of professionals from different departments including PPMED, HITD, MCH, HEP and other partners, dedicated to the eCHIS development in Ethiopia. According to the ToR, PPMED is the chair of the TWG group while it is coached by the HEP program.

The presence of this TWG was identified as a facilitating factor for eCHIS implementation in the country. However, the lack of similar structures (i.e. TWG) at regional and lower levels was as a bottleneck for the implementation.

"eCHIS is led by TWG at MOH level, this TWG encompasses individuals from the HIT department, PPMED, HEPD, MCHD and other consultant members. This TWG consult HIT directorate and PPMED. The TWG have ToR, based on the ToR the technical working group is chaired by the PPMED and it is coached by the health extension program directorate..." (MOH eCHIS team lead)

The TWG at MOH meets regularly, every week, to discuss challenges, provide feedback, and present new ideas for eCHIS implementation. However, issues such as irregular attendance of members in the TWG meetings, limited coordination, and conflicts of interest among members of TWG were also noted. Additionally, stakeholders mentioned insufficient formal and regular meetings and communications across all government structures, implementing partners, and eCHIS center of excellence. Communication and meetings within regional, zonal and woreda level organizations were also reported to be poor and infrequent.

The presence of informal communication platforms such as, social media Telegram channels, were highlighted as prominent means of communication across all implementing organizations, along with a recently deployed support forum.

Stakeholders noted the existence of the eCHIS center of Excellence as a means to sustain and institutionalize eCHIS implementation within government structures in the future. However, the lack of ToR outlining clear actions and deliverables prior to establishing the center was identified as a potential threat against achieving the intended outcome from the University as an excellence center.

"We have no MOU, but we incorporated it with CBMP document. We are working normally with MoH and two regions under our cluster Oromia and Gambella, so we work closely by proper utilization of our resource with these two regions as an integration. (focal person, eCHIS center of excellence)

The presence of bureaucratic procurement and distribution procedures at MoH and Ethio-telecom was mentioned as barriers to the timely and effective implementation of eCHIS.

"To replace those deactivated sim-cards, there is a long bureaucratic to be follow … The bureaucracy to receive the sim-cards takes a minimum of one month, when such problems occur it delays the implementation of eCHIS" (logistic team lead, MOH)

According to key informants, some HEWs feel threatened by the, the GPS coordinates collected through the eCHIS app, is designed to control them. Similarly, some health extension workers mentioned that client's feel threatened those HEWs taking a map of their house when they visit houses for registration and service provision using eCHIS. Such misunderstandings between the perception aim of the coordinates and HEW's and client's to it needs to be addressed through proper communication.

"… There is a GPS on eCHIS and there is a 'record' shortcut in the menu; by misconception, HEWs understood these as if higher-level supervisors use to monitor them to monitor their work. Moreover, when you carry your tablet and take the GPS coordinates of the households, community members often refuse, as they perceiving that HEW comes to their households to take site plan or map of their house... since it is new to the community it has a challenge" (Health extension worker)

Most of the stakeholders agree that the leadership is committed to implementing eCHIS and explained that commitment by the availability of a steering committee led by the Minister of health MoH, the assigned budget (which is exceeds other health expenditures), and the high-level advocacy through social and media and review meetings. stakeholders criticized the limited involvement/ active interest of leaders, the limited functionality of the steering committee, limited advocacy and gap in governance regarding eCHIS saying the implementation is not well structured or managed.

"…Government has allocated huge substantial resources to the program, indicates its commitment. Only for training, the government allocated around 100 million birr, and a similar amount of money is invested in tablet purchases. The funds allocated for data subscriptions and sim cards are also significant, for me, there is nothing that proves the commitment of the government more than this. Secondly, the minister of MoH by herself advocate on eCHIS which indicates

how much priority is given to the program" (KII, Partner organization)

Most stakeholders believe that political directive is necessary to support eCHIS implementation in the country, and its absence is one of the factors impeding implementation and raising concerns about the system's priority status.

"…The system does not receive attention from structural and political leaders. I haven't seen any forums for discussion concerning eCHIS implementation by the political and structural leaders for the past one and half year". (eCHIS focal, RHB)

Stakeholders reached a consensus regarding the lack of budget code, insufficient funding to support the implementation of eCHIS including training, air time, tablet procurement, and maintenance and lack of budget assigned for mentorship.

"…However, there is no specific budget allocated for eCHIS implementation, even there is no budget code for eCHIS implementation, and it is a limitation". (Regional M&E director)

Although the majority of stakeholders mentioned having a sufficient number of tablets for HEWs, the quality of the tablets is very poor and is currently hindering household registration, service provision, and synching of data to the server. Moreover, stakeholders are skeptical that the current quality of the tablets will support eCHIS for a long time. In addition, stakeholders noted the lack of tablets at health center and woreda level negatively influences the support provided to HEWs.

"…tablets and other supplies are distributed based on the request from the regional health bureaus, so I think it is adequate. However, the type of tablet distributed may be a problem … HEWs are struggling due to the poor performance of the provided tablet, which fails to log in and store data as well as the problem in the sim cards to sync the data" (KII, MOH Logistic team).

Stakeholders also mentioned a lack of quality and an insufficient number of servers, as well as an inadequate backup mechanism, posing a risk of losing data generated by eCHIS. Servers are shut down on weekends and holidays, which causes delays in data synchronization. Due to these server issues and the large amount of un-synced data, health extension workers lose interest in eCHIS , and they become less motivated.

"The available physical server memory and storage do not align with the actual activity and overall demand. Around 18 virtual servers have been created, and now we are currently using those virtual servers. High-performance servers are required to handle the large data being synched from each health post." (explained by the MOH HITD director)

The lack of sufficient number and mix of professionals at all levels, resulting from the absence of human resources assigned solely to eCHIS implementation, was identified as a major barrier. Additionally, the turnover of HEWs and HIT professionals job/salary dissatisfaction as well as limited opportunities for professional growth for HEWs, was mentioned as a significant barrier related to human resources.

"We can say there are no professionals assigned specifically for the eCHIS program. There is a critical scarcity of human resource working eCHIS program. In addition, there is no appropriate mix of professionals to meet the program's needs." (stated the MOH PPMED director)

While some stakeholders emphasized the importance of incentivizing employees as a means of ensuring effective implementation, others expressed concern that it might not produce the desired results if it is not fairly rewarded and if is not sustainable. The lack of standardized incentivizing and rewarding mechanisms at all levels of the organizations was also widely noted.

"Of course, incentives can motivate individuals, but the incentive may have advantages or disadvantages. If the incentive is sustainable, it is beneficial s however if it is not sustainable it may have significant negative impacts." (RHB plan M&E director)

Stakeholders also raised concerns that eCHIS is not institutionalized within government structures since most of the budget for activities-including human resources, mentorship and procurement is primarily supported by partner organizations.

Stakeholders mentioned limited pre-implementation readiness, noting that the eCHIS implementation guidelines were not distributed before the start of the implementation and that there is lack of strategic document on how to implement it. Most of the stakeholders indicated they were unaware of the eCHIS implementation guidelines. Although a few mentioned receiving the guideline via email, they felt it was not well publicized and indicated that they are not using it. Furthermore, stakeholders expressed concern that the current eCHIS implementation guidelines lack clarity on how it will be implemented.

"There was no distributed guideline or manual for the implementation of eCHIS. Only training was provided for health extension workers. TOR was not developed, and overall pre-implementation readiness assessment was not properly conducted,". (RHB plan M&E director)

The availability of sufficient expertise to provide eCHIS training and the adaptation of different approaches during training for HEWs was raised as an important factor that supported eCHIS implementation. However, stakeholders doubted that the assigned number of training days (five days for each module) are not sufficient to provide/acquire the required knowledge and skill for HEWs. Additionally, stakeholders mentioned the need for refresher or booster training to maintain the knowledge and skill they acquired during the training.

"We have senior experts, who have ample exposure, since the master ToT. When we prepare each training we involve these individual s, even though they are in different locations. We also include experts who have completed the regional ToT, as well as many experts at the partner level. At the zonal level, we have identified experts during previous training sessions. When we provide training, we identify active participants. When we provide training, we identify active participants in,

and the next time we prepare training, we bring them in as assistants to help us. They assist with the training and then we give them thea opportunity to lead some sessions. After guiding them to train others, we now have amazing experts in each zone,". (explained the RHB eCHIS focal)

Characteristics of individuals: -*Knowledge & Beliefs about the Intervention, Self-efficacy, Individual Stage of Change, Individual Identification with Organization*

Health extension workers feel that the emergence of electronic CHIS in Ethiopia is very important, as it reduces their workload and are pleased using the system. Additionally, given their long-term knowledge and skills they have with paper-based CHIS, HEWs find g using eCHIS easy. This sentiment is also echoed by other stakeholders.

".. it is not difficult to use. For me, it is better and simpler to provide service with eCHIS. So, I believe there is no difficulty in using eCHIS." (stated a KII, from a Partner organization)

Health extension workers reported a lack of regular mentorship and discussions about the challenges they facee with the HC and woreda focal points in order to effectively implement eCHIS.

"There is no mentoring or supportive supervision from the health center HEP focal person. As I mentioned during your first visit, we haven't seen any supervision from the health center HEP focal." (said Health extension worker)

Individual negligence in delegating responsibility at HC and HP levels, the expectation of orders or direction from higher officials, a lack of accountability, and a refusal to seek assistance during difficulties were cited as individual barriers to eCHIS implementation.

"…However, there is also negligence from the end-users. They are not performing activities responsibly and expect pressure from higher-level health center staff and Woreda health office officials. They don't want to ask for any support, citing the difficulties they face,." (PHCU HEP focal)

Process; - Planning, Engaging, Executing, Reflecting & Evaluating

Stakeholders mentioned poor planning ahead of eCHIS implementation. The gaps in planning were attributed to a lack of strategic planning, cost-benefit or effectiveness assessments, failure to define the budget needed for implementation in advance, lack of need-based planning, and the absence of a roadmap for transitioning from CHIS to eCHIS. This includes unclear guidelines on when to phase out paper CHIS, the timeline for implementation, and how often to replace tablets. According to health extension workers, the simultaneous use of paper-based and electronic CHIS adds to their burden.

"… There is no roadmap, no clear information on when it starts and ends, no guidelines change management, such as how the transition from paper-based CHIS to eCHIS will occur. We are creating a burden on the HEWs. … In my opinion, tablets should be replaced every three to five years,." (stated a KII, from a Partner organization)

Some stakeholders perceive the plans and goals set by the MOH as ambitious and unfeasible. For example, regional stakeholders mentioned that the direction to complete household registration before providing any service using eCHIS was made without their input and is hindering the system's adaptation. They also felt this directive causes HEWs to forget the RMNCH training they have already received.

"It is well known that we are ambitious in our planning; we have no problem in developing and documenting the plan. The issue lies in execution. After the plan is developed, the leadership is expected to raise funds for the implementation of the program." (remarked the RHB plan M&E director)

Despite the plan alignment exercise among MoH, lower-level government structures and implementing partners, regional stakeholders feel they were not adequately engaged during the drafting of the initial plans and noted that the Zonal health departments were also not involved.

"They (the MoH) didn't engage us in the planning. They drafted the plan and allocated the through a letter. The same is true for some partner organizations; when they introduce program for implementation in the region, they select areas already designated for other partner organizations resulting in duplication of effort." (explained the RHB plan M&E director)

Although there is a designated team leader for eCHIS at the MoH level, stakeholders believes this is insufficient to support eCHIS implementation.

"There is a scarcity of professionals in eCHIS program. Additionally, it lacks the required professional mix. As it was seen in some regions, they assigned IT but they only support tablets or technology, not health programs. The others assigned only health professionals but they may not have technological knowledge, so it would be better to assign a health informatics professional with both skills sets," (stated the MoH HITD director)

Stakeholder engagement and coordination in eCHIS implementation, from application software development to system implementation, including human resource placement, capacity building, mentorship, and support for the center of excellence, were described as major facilitators for eCHIS implementation in the country.

"…partner involvement is very important; they have identified woredas to support; has trained the staffs and are now on implementing the program. From our observation and evaluation, woredas supported by partners have shown better performance, likely due to the continuous and uninterrupted mentorship they provide to the facilities. They have the resources and they provide continuous mentorship and supportive supervision. Since they have experts at the regional level, they provide timely expert support. As the woredas supported by the partners are performing better compared to the other woredas, I believe their involvement is crucial for the implementation of eCHIS." (noted the RHB HIT director)

Although the eCHIS center of excellence is at its initial stage, stakeholders mentioned its low engagement with the government structures including MoH and RHBs. Additionally, because there is no distinct deliverables to measure against, the center's activities are not sufficiently monitored.

"…At different times, we have discussed the center of Excellence with partners and MoH, but we have not reached a consensus on the list of deliverables to be achieved by center of excellence. As a result, there are no activities on monitoring and evaluation concerning eCHIS" (stated a KII, eCHIS center of excellence)

As a result of poor documentation and organization before distribution, the whereabouts and functionality of tablets and SIM cards are unclear. This has impacted household registration and service provision using eCHIS. To address this, the ministry has developed a system to be integrated with the upcoming version of DHIS2 that will help register tablets and SIM cards from each PHCU aiming to ascertain the exact number of tablets and SIM cards including their functionality status. Stakeholders raised the need for tablet management software; although it's high cost is a concern.

"…this year we have developed and customized DHIS2 to monitor eCHIS implementation. It can inform us about the number of facilities that have implemented eCHIS system, the number of malfunctioned tablets, and the number of facilities that have started referral linkages using eCHIS, including the woreda and health post" (noted the MoH HITD director)

Due to poor monitoring mechanisms, a lack of regular meetings to discuss challenges and opportunities, insufficient formal activity reporting mechanisms (in addition to the eCHIS dashboard), inadequate supervision, barely existent mentorship, and a lack of functional feedback loop, eCHIS goals are often not acted upon, activities are not sufficiently followed up, and signs of progress are not checked against feedbacks.

"…We do not have a structured and standardized monitoring and evaluation system for the implementation of eCHIS." (stated the MoH HITD director)

Discussion and practical implications

This study assessed the major barriers and facilitators to eCHIS implementation in Ethiopia and contributed to practice and policy for the optimization of eCHIS implementation. Using the CFIR framework, we interviewed key stakeholders at various levels of the Ethiopian health system to identify various challenges in the implementation of eCHIS. Our study demonstrated the numerous benefits of eCHIS including improvement of service provision, data quality and data use. However, its adoption in the country is limited due to poor monitoring mechanisms, lack of resources and insufficient governing documents. These findings align with a recent study conducted in northwest Ethiopia (6).

The findings in our study indicate that eCHIS is superior to traditional paper-based CHIS in terms of ease of use, data handling, data exchange, and receiving updated information. Mobile Health solutions are simpler to use, quick identification and registration of client information, and support community workers as they provide services and go about their daily tasks (7–9). Although the job aid nature of eCHIS modules has helped HEWs to provide standardized service, we recommend limiting the size of modules and messages to avoid client frustration and promote service utilization.

The poor performance of tablets ,including touch sensitivity, sluggish screens, and limited cellular network coverage in districts where health posts are located, were critical bottlenecks to the use of eCHIS in Ethiopia. Evidence indicated the need to carefully inspect the functionality of smartphones and tablets before and during implementation of electronic systems (8,10). To ensure long-term functionality and maintain adequate performance while avoiding frequent service interruptions, it is essential to establish a minimum specification standard for tablets prior to procurement. Effectively implementing mHealth technologies can be difficult in areas with poor internet connectivity and frequent power outages, particularly in rural regions (7). Similar difficulties with data synchronization (causing delays in reporting of data) and tablet charging highlighted the need for alternative power and network sources.

Consistent with barriers to the implementation of mobile health solutions in the African region, a WHO overview indicated that an insufficient amount of available resources to support mHealth technology implementation pose a major challenge. Our study revealed that, shortage of tablets, inadequate quality and quantity for data backup, and unreliable backup generator (which only functions on weekdays) present in an imminent risk of data loss. These factors are critical for the proper functioning of the system and call for further resource mobilization in the future.

Community Health Workers find it challenging to keep up with a program and fill in skill gaps in the absence of refresher training and supportive supervision (11, 13). Our study also underscores the need for additional focus on mentorship, supervision, and booster trainings.

The availability of an implementation roadmap, strategies, and guidelines will help standardize the nation's adoption of eCHIS. As a result, our team suggested developing a strategic document outlining how to implement eCHIS, including a timeline for implementation and rollout as well as change management from CHIS to eCHIS. We urge the development of a thorough legal framework detailing how the system will be governed, put into effect, and maintained over time. A recent scoping review also identified limited funding sources and a lack of government policies as significant barriers to mHealth solution implementation (14).

The lack of privilege to generate custom reports and visualization at regional level hinder s regional focal persons from effectively monitoring eCHIS services

and tailoring feedbacks. We encourage the decentralization of the system by granting regional experts access to selected features of the app and strengthening the analytical capabilities of eCHIS.

Our study highlighted the importance of informal communication in obtaining support at all levels of the health system and exchanging information. In addition to this informal communication, creating a formal monitoring system is critical to ensuring efficient activity tracking and providing tailored feedback.

Participants in this study argued that it is unlikely that the eCHIS program will become institutionalized because partner organizations typically provide the most of the funding for eCHIS activities, including human resource availability, mentorship, and procurement. According to this study, organizational structures such as TWGs at all levels and an eCHIS center of excellence have the potential to enhance and institutionalize eCHIS implementation in the country. Establishing a memorandum of understanding and clear sets of deliverables for the eCHIS center of excellence, along with it's active engagement in eCHIS-related activities, could facilitate the institutionalization and adoption of eCHIS into the country's health system. In addition, strengthening the support forum for eCHIS experts and maintaining the regular and functional of TWG meetings at all levels is essential.

Furthermore, strengthened collaboration with all key stakeholders and active engagement of leaders are critical for optimizing eCHIS implementation, which, in turn, will improve service provision and health outcomes.

Future research should explore challenges to scaling-up, disseminating best practices, and ensuring the sustainability of eCHIS. Moreover, as this study was primarily conducted in agrarian regions, it is important to understand the factors affecting urban and agro-pastoral regions to provide practical guidance that supports further adoption of eCHIS in diverse settings across the country.

Conclusion

The electronic Community Health Information System (eCHIS) offers several advantages, including ease of use, reduced workloads, standardized services, improved data quality, and more efficient service delivery and referrals.

Despite its potential to enhance the health system, the implementation of eCHIS has been hindered by the lack of clear governing documents, poor documentation, and inadequate monitoring mechanisms. Insufficient resources and infrastructure also pose significant challenges, necessitating further resource mobilization. Addressing these barriers early on is crucial for the successful implementation of eCHIS. High-quality backup servers and standardized tablets are essential for optimization. Furthermore, a Technical Working Group (TWG), an eCHIS steering committee, a center of excellence, and continued engagement of political leaders and partner organizations will be critical for ensuring the program's sustainability.

List of Abbreviations and acronyms

CFIR: Consolidated Framework for Implementation Research
CHIS: Community Health Information System
DHIS2: District Health Information System
eCHIS: electronic Community Health Information System
HEW: Health Extension Worker
HIS: Health Information System
HITD: Health Information & Technology Directorate
MOH: Ministry of Health
PHCU: Primary Health Care Unit
PPMED: Plan, Policy, monitoring and Evaluation Directorate
RHB: Regional Health Bureau
ToR: Term of Reference
TOT: Training of Trainers
TWG: Technical Working Group
WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethiopian Midwives Association Institution Review Committee (EMwA-IRC) with protocol number EMwA-IRB-SOP/015/02.0. Informed consent and permission to audio record interviews was obtained from all key informants prior to the interviews. Audio recordings of interviews didn't include any personal identifiers and all methods were carried out in accordance with ethical guidelines and regulations.

Availability of data and materials- The datasets used and/or analyzed during the current study are available and can be obtained from the corresponding author upon reasonable request.

Competing interests - The authors declare that they have no competing interests

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